

ADAM BOULAND

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ACADEMIC APPOINTMENTS **Assistant Professor of Computer Science**, Stanford University (July. 2021-present)
Postdoctoral Researcher, UC Berkeley/Simons Institute for the Theory of Computing, advised by Umesh Vazirani (Sept. 2017-June 2021).

EDUCATION **Massachusetts Institute of Technology**, Cambridge, MA
Ph.D. in Computer Science, September 2017, advised by Scott Aaronson
University of Cambridge, Cambridge, UK
M.Phil. in Advanced Computer Science, 2011, advised by Anuj Dawar
M.A.St. in Mathematics, 2010
Yale University, New Haven, CT
B.S. Computer Science & Mathematics, Physics, 2009
Summa Cum Laude, Distinction in Both Majors

AWARDS **NSF Graduate Research Fellowship**, 2011-2016
Marshall Scholar, UK Government, 2009-2011
Howard L. Schultz Prize, Yale Physics Department, 2009
Junior Inductee into Phi Beta Kappa (top 10 in class of >1000), Yale Chapter, 2007

ADDITIONAL POSITIONS **Technical Advisor**, QC Ware, Palo Alto, CA, June 2018-present
Near-term quantum algorithm development for quantum software startup.
Research Visitor: F. U. Berlin, June 2018 (Host: Jens Eisert), U. Bristol, Aug. 2016 (Host: Ashley Montanaro), Tokyo Institute of Technology, Dec. 2016 (Host: Tomoyuki Morimae), Joint Center for Quantum Information and Computer Science (QuICS), University of Maryland, Aug. 2015 (Host: Stephen Jordan), Centre for Quantum Technologies (CQT), Singapore, Jan.-Apr. 2014, Jun.-Aug. 2015 (Host: Miklos Santha).
Undergraduate Research, Yale, Stanford, 2008-2009
Designed algorithms to improve multi-way sparse cuts in graphs. Advised by Daniel Spielman. Created software to analyze cosmic microwave background anisotropies and galaxy cluster surveys. Advised by Richard Easther (Yale) and Risa Wechsler (Stanford).

TEACHING

Mentor, MIT SPUR and UROP programs for undergraduate research, Summers 2012, 2013, 2014 and subsequent semesters. Mentored undergraduate students on research projects in theoretical computer science and physics. Projects resulted in three publications. Students and projects included:

- Xue Zhang: Quantum Computing with Commuting Gate Sets (Summer 2014-Spring 2015)
- Mitchell Lee: Quantum Computing with Hidden Variables (Summer-Fall 2013)
- Hyun Sub Hwang: Quantum vs. Classical Oracles (Summer 2013)
- Lynn Chua: Psi-Epistemic Theories (Summer-Fall 2012)
- Mark Velednitsky: Graph Isomorphism and Crossing Number (Summer 2012)

Teaching Assistant, Quantum Complexity Theory, MIT Subject 6.845, Fall 2014

Grader, Quantum Complexity Theory, MIT Subject 6.845, Fall 2012

PUBLICATIONS

Please note: Author ordering is by default alphabetical in my field

[18] A. Bouland, B. Fefferman, Z. Landau and Y. Liu. “Noise and the frontier of quantum supremacy.” In submission. arXiv:2102.01738 (2021).

[17] A. Bouland, B. Fefferman, and U. Vazirani. “Computational pseudorandomness, the wormhole growth paradox, and constraints on the AdS/CFT duality.” In *2020 ACM Conference on Innovations in Theoretical Computer Science (ITCS’20)*. arXiv:1910.14646 (2019).

[16] J. Haferkamp, D. Hangleiter, A. Bouland, B. Fefferman, J. Eisert, and J. Bermejo-Vega. “Closing gaps of a quantum advantage with short-time Hamiltonian dynamics.” *Physical Review Letters* 125, 250501, arXiv:1908.08069 (2021).

[15] A. Bouland, B. Fefferman, C. Nirkhe, and U. Vazirani. “On the Complexity and Verification of Quantum Random Circuit Sampling.” *Nature Physics* 15, pp. 159–163. Abstract in *Proc. 2019 ACM Conference on Innovations in Theoretical Computer Science (ITCS’19)*. arXiv:1803.04402 (2019).

[14] S. Ben-David, A. Bouland, A. Garg and R. Kothari . “Classical Lower Bounds from Quantum Upper Bounds.” In *Proc. 59th Annual IEEE Symposium on Foundations of Computer Science (FOCS’18)*. arXiv:1807.06256 (2018).

[13] A. Bouland and M. Ozols. “Trading Inverses for an Irrep in the Solovay-Kitaev Theorem.” In *Proc. Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC’18)*. arXiv:1712.09798 (2018).

[12] A. Bouland, D. Koh and J. Fitzsimons. “Complexity Classification of Conjugated Clifford Circuits.” In *Proc. 33rd Conference on Computational Complexity (CCC’18)*. arXiv:1709.01805 (2018).

[11] S. Aaronson, A. Bouland, G. Kuperberg and S. Mehraban. “The Computational Complexity of Ball Permutations.” In *Proc. 49th ACM Symposium on the Theory of Computation (STOC’17)*. arXiv:1610.06646 (2017).

[10] A. Bouland, L. Chen, D. Holden, J. Thaler, and P. N. Vasudevan. “On the Power of Statistical Zero Knowledge.” In *Proc. 58th Annual IEEE Symposium on Foundations of Computer Science (FOCS’17)*. To appear in *SIAM Journal on Computing (SICOMP)* special issue for FOCS’17. arXiv:1609.02888 (2017).

- [9] N. Bao, A. Bouland, A. Chatwin-Davies, J. Pollack and H. Yuen. “Rescuing Complementarity with Little Drama.” *Journal of High Energy Physics* 2016:26. arXiv:1607.05141 (2016).
- [8] I. Arad, A. Bouland, D. Grier, M. Santha, A. Sundaram, and S. Zhang. “On the Complexity of Probabilistic Trials for Hidden Satisfiability Problems.” In *Proc. 41st International Symposium on Mathematical Foundations of Computer Science (MFCS ‘16)*. arXiv:1606.03585 (2016).
- [7] A. Bouland, L. Mančinska and X. Zhang. “Complexity Classification of Two-Qubit Commuting Hamiltonians.” In *Proc. 31st Conference on Computational Complexity (CCC’16)*. arXiv:1602.04145 (2016).
- [6] N. Bao, A. Bouland and S. Jordan. “Grover Search and the No-Signaling Principle.” *Physical Review Letters* 117, 120501. arXiv:1511.00657 (2016).
- [5] S. Aaronson, A. Bouland, J. Fitzsimons and M. Lee. “The Space ‘Just Above’ BQP.” In *Proc. 2016 ACM Conference on Innovations in Theoretical Computer Science (ITCS’16)*. arXiv: 1412.6507 (2016).
- [4] A. Bouland and S. Aaronson. “Generation of Universal Linear Optics by Any Beamsplitter.” *Physical Review A* 89, 062316. Editor’s Suggestion. arXiv:1310.6718 (2014).
- [3] S. Aaronson, A. Bouland, L. Chua and G. Lowther. “Psi-Epistemic Theories: The Role of Symmetry.” *Physical Review A* 88, 032111. Editor’s Suggestion. arXiv:1303.2834 (2013).
- [2] A. Bouland, A. Dawar and E. Kopczyński. “On Tractable Parameterizations of Graph Isomorphism.” In *Proc. 7th International Symposium on Parameterized and Exact Computation (IPEC)* (2012).
- [1] A. Bouland, R. Easther and K. Rosenfeld. “Caching and Interpolated Likelihoods: Accelerating Cosmological Monte Carlo Markov Chains”. *Journal of Cosmology and Astroparticle Physics* 2011(05). arXiv:1012.5299 (2011).

EXPOSITORY WRITINGS

“Establishing Quantum Advantage.” XRDS: Crossroads, The ACM Magazine for Students. Volume 23 Issue 1, Fall 2016, Pages 40-44 (2016).

ORAL PRESENTATIONS

“Noise and the frontier of quantum supremacy,” Presented as a contributed talk at Quantum Information Processing 2021 (virtual).

“Pseudorandomness and the AdS/CFT Correspondence”, invited talk at Yukawa Institute for Theoretical Physics, March 2021, It from Qubit Workshop, December 2020, Workshop on Complexity from Quantum Information to Black Holes, Lorenz Center, Netherlands, June 2020.

**ORAL
PRESENTATIONS
CONT'D**

“Theoretical Computer Science at the Quantum Crossroads”/“Quantum physics at the Complexity Crossroads.” Special seminars at UC San Diego CSE/Math Colloquium, UC Berkeley Physics Colloquium, Stanford Computer Science Colloquium, Harvard Quantum Initiative Colloquium, UC Davis Computer Science Colloquium, UC Irvine Computer Science Colloquium, CU Boulder CS Colloquium, UC Santa Barbara Computer Science Colloquium, Spr. 2020.

“Quantum Supremacy Bootcamp I&II,” “Power and Limitations of the QAOA,” and “Computational Pseudorandomness and Constraints on the AdS/CFT Duality.” Invited lectures at the Simons Institute Quantum Wave in Computing program, Berkeley, CA, Spring 2020.

“Quantum Supremacy and its applications,” Invited lectures at IAS Winter School on The Mathematics of Quantum Computation, Jerusalem, Israel, December 2019.

“Quantum Supremacy and the Complexity of Random Circuit Sampling.” A. Bouland, B. Fefferman, C. Nirkhe, and U. Vazirani. Presented as a contributed talk at *Quantum Information Processing (QIP) 2019*, Boulder, Colorado, January 2019. Also presented at: Google quantum information seminar, Los Angeles, CA, April 2018. Stanford Institute for Theoretical Physics (SITP) seminar, Stanford, CA, May 2018. MIT Quantum Information seminar, Cambridge, MA, May 2018. FU Berlin Quantum Information seminar, Berlin, Germany, June 2018. Simons Institute lightning talk, July 2018.

“What you need to know about quantum algorithms” and “The Quantum Algorithms Landscape,” Q2B conference, Mountain View, CA, December 2018, December 2019, December 2020.

“Introduction to Quantum Complexity”, Invited talk at Quantum Information for Developers Summer School, ETH Zurich, Switzerland, September 2018.

“Classical Lower Bounds from Quantum Upper Bounds.” S. Ben-David, A. Bouland, A. Garg and R. Kothari. Presented as a contributed talk at *Quantum Information Processing (QIP) 2018*, Delft, Netherlands, January 2018. Presented as an invited talk at *Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC) 2018*, Sydney, Australia, July 2018.

“Quantum Advantage from Sampling Problems.” Stanford/Google X workshop on Quantum Information, Mountain View, CA, November 2017.

“The Space Below BQP.” Quantum Innovators in Math and Computer Science Workshop, Institute for Quantum Computing, Waterloo, Canada, September 2017.

“The Space Around BQP.” MIT Thesis Defense, June 30, 2017

“On the Power of Statistical Zero Knowledge.” A. Bouland, L. Chen, D. Holden, J. Thaler and P. Vasudevan. UT Austin Theory Colloquium, May 2017.

“Grover Search and the No-Signaling Principle.” N. Bao, A. Bouland and S. Jordan. Stanford Institute for Theoretical Physics Seminar, Stanford, CA, February 2017. U. Bristol Quantum Information seminar, Bristol. UK, August 2016.

“Equivalence of Adiabatic and Circuit Based Quantum Computing” and “Why physicists should care about the complexity zoo.” It from Qubit Summer School Focus Lectures. Waterloo, Canada, July 2016.

**ORAL
PRESENTATIONS
CONT'D**

“Complexity Classification of Two-Qubit Commuting Hamiltonians.” A. Bouland, L. Mančinska and X. Zhang. Presented as a contributed talk at *Quantum Information Processing (QIP) 2016*, Banff, Canada, January 2016. Also presented at QuICS Seminar, University of Maryland, September 2015. Centre for Quantum Technologies - Computer Science Seminar, Singapore, August 2015.

“The Space ‘Just Above’ BQP.” S. Aaronson, A. Bouland, J. Fitzsimons and M. Lee. Invited talk, The space around BQP [workshop], Tokyo, Japan, December 2015.

“Generation of Universal Linear Optics by Any Beamsplitter.” A. Bouland and S. Aaronson. Presented as a contributed talk at *Quantum Information Processing (QIP) 2015*, Sydney, Australia, January 2015. Also presented at Centre for Quantum Technologies - Computer Science Seminar, Singapore, February 2014.

**SERVICE &
OUTREACH**

Program Committee Member: Foundations of Computer Science (FOCS) 2019, Quantum Information Processing (QIP) 2020.

Member: Computing Use Case Technical Advisory Committee, Quantum Economic Development Consortium (QEDC), 2019-2021.

Quoted in media articles: Quanta Magazine (2019), Esquire (2019).

Co-organizer, Quantum CS (QuaCS) group meeting, 2015-2017 (joint with Robin Kothari)

Reviewer or Subreviewer for: Computer Science & Math Venues: Symposium on the Theory of Computing (STOC), Foundations of Computer Science (FOCS), Computational Complexity Conference (CCC), Symposium on Discrete Algorithms (SODA), International Colloquium on Automata, Languages and Programming (ICALP), Innovations in Theoretical Computer Science (ITCS), Theory of Computing (ToC), ACM Transactions on Computing Theory (ToCT), Symposium on Theoretical Aspects of Computer Science (STACS), International Conference on Randomization and Computation (RANDOM), Theory of Cryptography Conference (TCC), International Conference on the Theory and Applications of Cryptographic Technique (EUROCRYPT), International Symposium on Mathematical Foundations of Computer Science (MFCS), Information Processing Letters (IPL), IEEE Transactions on Neural Networks and Learning Systems (TNNLS), IEEE Transactions on Knowledge and Data Engineering (TKDE), Computing and Combinatorics Conference (COCOON), Mathematical Reviews (MathSciNet), SIAM Review (SIREV). **Physics & Quantum Computing Venues:** Quantum Information Processing (QIP), Physical Review Letters (PRL), Physical Review A (PRA), Nature Partner Journal Quantum Information (NPJQI), Quantum, Proceedings of the Royal Society A (P. R. Soc. A), Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC), Quantum Information & Computation (QIC), Quantum Information Processing (QINP).